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Effect of Sugarcane Bagasse on Growth Performance of *Hereropneustes fossilis* (Bloch.) Fingerlings

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ABSTRACT: The present investigation has been conducted to evaluate the effect of sugarcane bagasse as an artificial substrate on growth performance of *Heteropneustes fossilis* figerlings for a period of 120 days. Sugarcane bagasse bundles (Length 50 cm; diameter 4cm) of 5 kg were hung in large cement tanks (5x5x1 m) with 15 cm soil base with well water in 6 of the 9 tanks randomly at the rate of 5 kg each, by suspending the bundles at regular distances from bamboo poles kept across the tanks. Fingerlings of *H. fossilis* (av. wt. 3.15 g) were stocked at 40 per tank two weeks after the addition of manure and substrate. No feed was provided to the fish in 3 of the substrate-added tanks (T_1), while a pelleted diet was fed to the fish in the remaining 3 substrate-added tanks (T_2) and the other 3 tanks without substrate (T_3). Individual fish in each tank were weighed at the start and every 14 days to monitor growth response and feed utilization. Water quality parameters (dissolved oxygen, pH and ammonia) were also monitored. Fish growth performance and nutrient utilization were determined for fish Mean weight gain (MWG), Specific growth rate (SGR), Protein efficiency ratio (PER), Feed conversion Ratio (FCR), Protein intake (PI) and fish Survival rates (SR %). Fish carcass was also analyzed for crude protein, lipid and ash in all treatments at the end of 120 days. The weight gain of the fish showed a significant response. Specific growth rate showed a high value in bagasse and supplemental feed group (T_2) followed by sugarcane bagasse alone used group (T_1). The feed intake value is more or less similar in all the three groups. PER and FCR values also showed high in substrate + supplemental feed group. The survival rate value recorded maximum in T_1 group. In fish carcass composition, the dry matter showed the order $T_2>T_3>T_1$. Crude protein and lipid values are more in substrate alone added group (T_2), but the ash value is more in T_1 group. These results showed that sugarcane bagasse can effectively be use as a substrate for the culture of the catfish *Heteropneustes fossilis.*

Key words: Sugarcane bagasse, artificial substrate, *Heteropneustes fossilis*

Introduction

In modern aquaculture, feeding is one of the major elements of cost of production and may amount to 50 per cent or more. In most traditional aquaculture practices, herbivorous or omnivorous species have been preferred as they feed on natural food organisms in water, the growth of which can be enhanced through fertilization and water management (Pillay, 2001). But carnivorous species generally need a high protein diet and are therefore considered to be more expensive to produce, even though the costs will depend largely on local availability and price for the required feed stuffs. To compensate for feeding costs, most carnivorous species command higher market prices. Such species generally have greater export markets and therefore attract substantial investments. Species that are hardy and can tolerate unfavourable conditions will have the advantage of better survival in relatively poor environmental conditions that may occur occasionally in culture situations. In the present study *Hetropneustes fossilis* has been selected because the ability to adapt to fresh and brackish waters with very low oxygen content and to grow under generally poor environmental conditions make these fish extremely valuable for small and large scale rural fish farming (Pillay, 2001). Substrate-based farming practices are considered viable low-cost technologies as they help in sustainable aquaculture production (Dharmaraj et al.2002). Sugarcane bagasse is the fibrous residue remaining after sugarcane stalks are crushed to extract their juice, generated in large quantities and is currently used as a renewable resource in the manufacture of pulp and paper products and building materials. This investigation is to find out the effect of substrate (sugarcane bagasse) on growth performance of *Heteropneustes fossilis* fingerlings.

Materials and Methods

Irrespective of sex, healthy fingerlings of *H. fossilis* (2 ± 2 cm length and 3.12 ± 2g weight) were collected locally from a single population and confined to large cement tanks in the laboratory. The experiment was conducted over a period of 120 days in nine 25 m^2 (5 X5 X1 m) cement tanks with 15-cm soil base following the method of Dharmaraj et al. (2002). In all the tanks initially added 0.25 kg of quick lime and 2.5 kg of poultry manure. Water was filled to the tanks from a perennial well and a depth of 90 ±2 cm was maintained throughout the experimental period. Subsequently, poultry manure was applied at 0.3 kg per tank every 15 days. Sugarcane bagasse, procured locally, was sun dried and bundles were made using nylon rope; they were introduced into 6 of the 9 tanks randomly at the rate of 5 kg each, by suspending the bundles at regular distances from bamboo poles kept across the tanks. After 45 days, once again 1.25 kg of the substrate was supplemented to each of the designated tanks. Fingerlings of *H. fossilis* (av. wt. 3.15 g) were stocked at 40 per tank (16 000·ha^{-1}) two weeks after the addition of manure and substrate. No feed was provided to the fish in 3 of the substrate-added tanks (T_1), while a pelleted diet, formulated according to Varghese et al. (1976) (Table 1) was fed to the fish in the remaining 3 substrate-added tanks (T_2) and the other 3 tanks without substrate (T_3) at 5% body weight for the first 30 days and 2% thereafter, in two equal rations daily. Individual fish in each tank were weighed at the start and every 14 days to monitor growth response and feed utilization. Water quality parameters which include dissolved oxygen, pH and ammonia were kept within the range of 6.7-6.9 (mg/l), 7.2-7.8 and 0.16-0.18 (mg/l), respectively and were considered favourable in fish culture tanks according to Boyd (1990). Fish growth performance and nutrient utilization were determined according to the methods of Jobling (1983) for fish Mean weight gain (MWG), Specific growth rate (SGR), Protein efficiency ratio (PER), Feed conversion Ratio (FCR), Protein intake (PI) and fish Survival rates (SR %). Fish carcass was analyzed for crude protein, lipid and ash using the methods of AOAC (1990) in all treatments at the end of 120 days. The experiment consisted of a completely randomized design with three replicates for each three dietary treatments. Statistical analysis of the data included the one-way analysis of variance (ANOVA) using the SPSS version 10.0 for windows on PC (Statistical Graphics Corp, US). Significant mean differences were separated at 5% using the methods of Steel et al. (1997) whereas appropriate and values are expressed as means ± SE.

Table1. Ingredient proportion and proximate composition of feed (wet weight basis)

Ingredient	%	Proximate composition	%
Fish meal	25	Moisture	7.29 ± 0.13
Rice bran	40	Crude protein	28.17 ± 0.66
Groundnut oil cake	25	Crude fat	3.15 ± 0.08
Tapioca flour	10	Crude fibre	15.90 ± 0.54
		Ash	13.80 ± 0.62
		NFE	31.69
		Energy content ($Kg.J^{-1}$)	12.50

*Average of three values ± S.E

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Results and Discussion

The growth response of *H. fossilis* using sugarcane bagasse as a substrate for 120 days is given in table 2. The weight gain of the fish after 120 days showed a significant response. Specific growth rate showed a high value in bagasse and supplemental feed group (T_2) followed by sugarcane bagasse alone used group (T_1). The feed intake value is more or less similar in all the three groups. PER and FCR values also showed high in T_2 group. The survival rate value recorded maximum in T_1 group (Table 2). In fish carcass composition, the dry matter showed the order $T_2>T_3>T_1$. Crude protein and lipid values are more in T_2 group, but the ash value is more in T_1 group. More details are given in table 3.

Table2. Growth response of *Heteropneustes fossilis* fingerlings

Parameters	T_1	T_2	T_3
Initial Weight (g)	3.15 ± 0.25	3.17 ± 0.22	3.15 ± 0.21
Weight gain (g)	21.38 ± 0.55*	25.18±0.10*	22.35 ± 0.20*
Feed intake (g)	26.24 ± 1.10	26.25±1.00	26.24 ± 1.12
SGR (%/day)	1. 99±0.06	2.01 ± 0.04	1. 75 ±0.01
PER	0.75 ± 0.11	0.82 ± 0.25	0.79 ± 0.22
FCR	1.28 ± 0.02	1.38 ± 0.04	1.33 ± 0.06
Survival Rate (%)	99.00	98.50	98.45

* $p< 0.05$.

For optimum growth of fish and overall productivity of fish culture a variety of nutrient carriers have been subject of many studies, and received much attention (Brady, 1991). The amount of different nutrients present in any natural aquatic environment is generally low and so unproductive, while the quantity required for the growth of fish and fish food organisms (phytoplankton, zooplankton and bottom fauna /flora) is comparatively large (Kumaraiah et al., 1997). When too much nutrient carriers (organic and inorganic) are used for fish culture, a substantial amount are lost through several ways and may become pollutants. Therefore, a large application of nutrient carriers may become hazards to fish (Kumaraiah et al., 1997). Although inorganic fertilizers and organic manure contain various essential elements, all of them are not necessary for fish growth, so need to be conserved and carefully managed (Brady, 1991). Organic substances such as plant materials, food scraps and paper products can be recycled using biological process. The intention of biological processing is to control and accelerate the natural process of decomposition of organic matter.

Table 3: Fish carcass composition after 120 days

Parameters (%)	T_1	T_2	T_3
Dry matter	82.16 ± 2.14	87.52±1.55	82.19 ± 2.10
Crude protein	15.18 ± 3.22	15.05 ± 2.20	17.31 ± 2.00
Crude lipid	12.80 ±1.10	11.84 ± 1.72	15.80 ± 2.70
Ash	0.56 ± 0.11	0.48 ± 0.16	0.45 ± 0.02

Development of viable low-cost technologies and their application to current farming practices would help in enhancing aquaculture production (Dharmaraj et al. 2002). Substrate based aquaculture is one such technology that has generated a lot of interest in recent years ((Wahab et al. 1999, Tidwell et al. 2000, Azim et al. 2001, Keshavanath et al. 2001). By providing organic matter and suitable substrates, heterotrophic food production can be increased several folds which in turn would support fish production. Substrates provide the site for epiphytic microbial production, consequently eaten by fish-food organisms and fish. Fish harvest microorganisms directly in significant quantities, either from microbial biofilm on detritus or from naturally occurring flocks in water column. Our earlier study revealed that sugarcane bagasse not only affects water quality parameters but help to increase the growth of zooplankton (Radhakrishnan and Sugumaran, 2010). Hence it can effectively be used as a substrate for the growth of planktons in aquaculture ponds. Provision of substrate would therefore, be useful for the growth of microbial biofilm (Radhakrishnan and Sugumaran, 2010a). Apart from forming food for fish, biofilm improves water quality by lowering ammonia concentration (Langis et al. 1998, Ramesh et al. 1999). The growth performance of fish was the best in substrate + feed treatment, being significantly higher than in substrate-alone or feed-alone treatments; growth under T_2 treatment was higher over T_1 and T_3 treatments respectively. Fish growth in feed-alone treatment was higher than in substrate-alone treatment. In feed-alone treatment (T_3) fish achieved a 5-fold weight increment over the experimental period. This superior performance as compared to T_1 treatment could be attributed to the nutritional quality of the diet employed. The significantly better growth of fish in the combination treatment indicates that the species can efficiently utilize natural as well as artificial diets when provided together.

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